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DB Name	Query	Hit Count	Set Name
USPT	l2 and l8	10	L9
USPT	l7 and l3	22	L8
USPT	l4 near l6	80	L7
USPT	signal or command	815471	L6
USPT	l1 and l2 and l3 and l4	1	L5
USPT	hand$writ$	4832	L4
USPT	microphone	27297	L3
USPT	voice near command	1554	L2
USPT	vehicle and appliance	4348	L1

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l7 and l10	4

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Refine Search: l7 and l10 Clear

Search History

Today's Date: 5/21/2001

DB Name	Query	Hit Count	Set Name
USPT	l7 and l10	4	L11
USPT	l8 near l9	761	L10
USPT	recogniz$3	370483	L9
USPT	voice	50617	L8
USPT	l5 and l6	52	L7
USPT	command	153002	L6
USPT	l3 and l4	75	L5
USPT	microphone	27297	L4
USPT	l1 and l2	544	L3
USPT	hand$writ$	4832	L2
USPT	car or vehicle	372316	L1

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L11: Entry 3 of 4 File: USPT May 19, 1998

DOCUMENT-IDENTIFIER: US 5754430 A
TITLE: Car navigation system

ABPL:
A car navigation system including route judgment means for judging whether an input place name is suitable for a route extending to a destination, and judgment result output means for outputting a judgment result, so that a car can be guided and navigated along a suitable route extending to the destination by inputting a place name written on a road sign or the like. The judgment result is output with a voice message or image display. When plural place names are input, the judgment is made on each of the place names, and the most suitable place name is selected and output.

BSPR:
This invention relates to a car navigation system for obtaining information on a route which is suitable to guide or navigate a car (vehicle) to a destination by beforehand registering the destination and inputting at least one place name indicated on a road sign.

BSPR:
There has been known a car navigation system in which a route extending to a destination is preset, and a course to be selected, such as "turning to the left or right", "keeping straight on" or the like, is guided using voice synthesis or the like when a car arrives at the front side of a crossing or the like. In such a system, the course guide is made with synthesized voice or the like at all times irrespective of driver's need every time the car arrives at this side of a crossing or the like, and thus the voice may sound offensive to the driver's ear. In order to overcome such a disadvantage, a car navigation system for outputting road guide information with voice immediately when a request (navigation request) is made from a driver is proposed in Japanese Laid-open Patent Application No. Hei-5-99678.

BSPR:
In addition, a map display device for a car in which a destination and a current position can be set by inputting the names of places, etc. displayed on a map with voice is also proposed in Japanese Laid-open Patent Application No. Hei-3-257485.

BSPR:
Furthermore, for a solid road as shown in FIGS. 12(a) and 12(b) which has been recently developed in cities, the car position is indicated at the same position on a map which is displayed on a display unit or the like of a car navigation system when a car runs on any road of a high level road 121, a ground road 122 and an underground road (tunnel) 123. In order to avoid such a problem, Japanese Laid-open Patent Application No. Hei-4-219872 proposes a voice guide device in which a road environment is specified in accordance with a view from a car window, for example, (1) only a distance view can be taken because of high level road, (2) only a close-range view can be taken because of a general road, or (3) no view can be taken because of a covered road, and a guide sentence (message) is prepared in accordance with the specified road environment to perform the road guide with synthesized voice.

BSPR:
In the car having the navigation system, a driver drives his car while checking the position of the car or the course (direction) of the car by seeing a road sign as shown in FIG. 13. When the same place name as the final destination is

indicated on a road sign, the driver identifies the course without losing his way. However, the same place name as the destination is not necessarily indicated on a road sign. In this case, the driver must decide a suitable course on the basis of one or plural place names which are indicated on a road sign. Here, if the driver knows his way around an area in which he drives currently, he can decide the course on the basis of the names of places which will be passed until the car reaches the final destination (hereinafter these places are referred to as "via-places"). However, if he does not know well his way around the area, he cannot decide the suitable course. Therefore, there has been required a device in which by inputting the names of via-places displayed on road signs or the like, the car can be guided and navigated along a course which is suitable to lead the car to the final destination, on the basis of judgment as to whether it is suitable to lead the car to a course extending to the name of a via-place. In the car navigation system as disclosed in Japanese Laid-open Patent Application No. Hei-5-99678, a travel route must be preset, and this is a cumbersome work. A navigation system having an advance indication function as disclosed in Japanese Laid-open Patent Application No. Sho-60-202307 is designed to indicate a course to a car at every crossing by inputting a travel start point and a destination point. However, in the navigation systems of the Japanese Laid-open Patent Application Nos. Hei-5-99678 and Sho-60-202307 as described above, the judgment on "turning to the left or right", "keeping straight on", etc. is made on the basis of a road map to indicate a suitable course to a driver.

BSPR:
Therefore, for example, in a case where a crossing at which the car is to change its course is a solid crossing as shown in FIG. 14, a voice guide indicating "turn to the right OOmeters ahead" would be merely made insofar as a map data base is provided with no information indicating a solid crossing structure when the car is instructed at the solid crossing to change its course from a course in the north direction on a road A to another course in the east direction on a road B. However, various structures may be designed for solid crossings, and thus even when the course change (turning to the right) is beforehand indicated, it is unclear whether it is suitable to keep a right lane in accordance with the indication.

BSPR:
The present invention has been implemented to overcome the above problem, and has a first object to provide a car navigation system for guiding and navigating a car along a suitable route extending to a destination on the basis of place names which are indicated on road signs even when a general data base having no road environment data on the structures of solid crossings, etc. is used, and in other words, a car navigation system for assisting a driver to surely judge his route on the basis of the road signs even in a geographically unfamiliar area around which the driver does not know his way.

BSPR:
Furthermore, the present invention has a second object to provide a car navigation system which can surely guide and navigate the car to a suitable course even in such a case where the driver does not known an accurate place name (Japanese rendering or pronunciation) because in some cases the driver does not accurately know the pronunciations (the Japanese rendering) of some place names written in Kanji on road signs in a geographically unfamiliar area, and in which place names can be hand-written with characters such as Hiragana, Katakana or the like which are relatively easily input and easily recognizable even under a vibrational running condition.

BSPR:
In order to attain the above objects, a car navigation system according to a preferred embodiment includes route judgment means for judging whether an input place name is suitable for a route extending to a destination, and judgment result outputting means for outputting a judgment result of the route judgment means. Accordingly, by inputting a place name written on a road sign or the like, it can be suitably indicated which course should be selected. Therefore, even when the driver or the like does not recognize the geographical relationship between a destination and a place name written on a road sign or the like in a geographically unfamiliar area, he can take the suitable course on the basis of the place name written in the road sign or the like.

BSPR:

In a car navigation system according to the claim 2, place names indicated on a map which is reproduced and displayed on a screen by an image display device and data on pronunciations of the place names (written in Kanji) are provided to a road map data base. Therefore, place names such as via-places, etc. can be specified by inputting the place names with voice using a voice recognition device (in the following description, a via-place is defined as a place through which the car passes to the destination). Furthermore, when a hand-writing input device is used, the place names such as via-places can be also specified by inputting the place names in Hiragana or Katakana with a pen or the like. Accordingly, a hand-write character recognizing unit of this system can be more facilitated in construction than a hand-write input device which needs recognition of Kanji. In addition, it is difficult to accurately input complicated Kanji characters during running because of car vibration. On the other hand, the Hiragana or Katakana character input of the place names makes the hand-writing input operation more easily.

BSPR:
In a car navigation system according to another embodiment, in addition to an accurate (formal) pronunciation for each place name, data on other ways of pronunciation (hereinafter referred to merely as "pronunciations") for each place name may also be provided. Accordingly, even when the driver or the like does not known the formal place names because of a geographically unfamiliar area, the place names written on road signs, etc. can be input by voicing or hand-writing an adequate (informal) pronunciation for each place name.

BSPR:
For example, in the car navigation system having the place name input means using a voice recognition device and the judgment result output means using a voice synthesizer, when the driver or the like voices one or plural place names which are written on a road sign, the place name input means analyzes the voice and supply the input one or plural place names to the route judgment means.

BSPR:
On the basis of the datum on the current position of the car which is supplied from a car position detection device, the route judgment means recognizes the position at which the car is currently located, and judges whether a route containing a place whose name is input from the place name input means as a via-place name is suitable, thereby allowing the car to arrive at a destination (final destination) which is preset by destination setting means. If plural place names are input, the above judgment is made on each place name, and the most suitable one (place name, route) is selected and output.

BSPR:
Through the judgment as described above, the route is judged to be suitable when an angle at which a line connecting the car current position and the destination intersects to a line connecting the car current position and an input place-name point is below a predetermined threshold value. If there are plural input place-name points which satisfy the above angle condition (below the predetermined threshold angle value), a route containing a place name providing the smallest angle in these plural place names may be selected.

BSPR:
Furthermore, the suitability judgment may be made on the basis of the distance of a common portion between a route extending from the current position to the destination and a route extending from the current position to an input place name. Besides, the suitability judgment may be made on the basis of the distance of a route extending from the current position through an input place name (via-place) to the destination. In a case where a route extending to an input place name contains a route (road) such as a superhighway on which the car can run at a higher speed than on a general road, the distance of the road (superhighway) may be converted (reduced) to a shorter value than its actual distance (conversion of the distance on the basis of a preset reduction rate) to calculate the distance to the destination, and a route through which the car arrives at the destination most early may be selected/identified on the basis of the converted distance (calculated in consideration of an arrival time).

BSPR:
In the above system, the place name input means may be constructed by the hand-write character input device and the hand-write character recognition

device, and the judgment result output means may be designed to display a route which is judged to be suitable on a map which is reproduced and displayed on a screen of a display unit, and a line connecting the car current position and a via-place which is judged to be suitable.

DRPR:
FIG. 1 is a block diagram showing a car navigation system according to a preferred embodiment of the present invention;

DRPR:
FIG. 2 is a block diagram showing a car position detector;

DEPR:
FIG. 1 is a block diagram showing the overall construction of a car navigation system according to a preferred embodiment of the present invention. The car navigation system 1 includes a road map data base 2, a car position detector 3, a destination input means 4, a place-name input means 5, a navigation controller 7 having a route judgment means 6, a judgment result output means 8 and an image display device 9.

DEPR:
Reference numeral 2a represents an access request signal for accessing the road map data base 2, reference numeral 2b represents a data output signal to be output in response to the access request signal 2a, reference numeral 3a represents car position data, reference numeral 4a represents input information on the destination setting, reference numeral 5a represents input information on a place name which is a target for a route judgment, reference numeral 8a represents information on the judgment result, and reference numeral 9a represents a display unit driving signal such as a video signal or the like.

DEPR:
With respect to the pronunciation data, the data base format is designed so that plural ways of pronunciation (hereinafter referred to merely as "pronunciations") (i.e., not only one pronunciation) may be registered for each place name. Accordingly, with respect to place names which are hard to pronounce or liable to be mispronounced because these names are written in Kanji, plural pronunciations are beforehand registered for these place names so that the place name concerned can be specified with any one of the registered pronunciations for the place name. For example, plural pronunciations "Tokorozawa", "Tokorosawa", "Shozawa", "Shosawa", etc. are registered for the place name of Kanji character "". These plural pronunciations are managed so that the formal (i.e., correct) pronunciation and the informal pronunciations for the place name are discriminable from each other. Accordingly, when the current position of the car is requested to be audibly output to the driver or the like using the voice synthesis (i.e., so that the driver or the like can hear a synthesized voice representing the current position), the car navigation system 1 of this embodiment can voice to the driver the place name of the car current position with the formal pronunciation.

DEPR:
FIG. 2 is a block diagram showing an embodiment of the car position detector shown in FIG. 1. The car position detector 3 is designed so as to use jointly a dead reckoning navigation device 33 which successively calculates the position of the car on the basis of a direction signal 31a from a direction sensor 31 such as a gyro, a geomagnetic sensor or the like and a distance signal such as a pulse signal or the like which is output every predetermined unit travel distance from a travel distance sensor 32 such as a wheel rotation sensor or the like, and a GPS position measuring device 35 for detecting the position of the car on the basis of signals which are received from plural GPS satellites using a GPS reception antenna 34. Accordingly, even when it is impossible to receive waves from the GPS satellites, the current position of the car can be guessed by the dead reckoning navigation device 33.

DEPR:
The car position detector 3 is further provided with a travel locus calculation means 36 for obtaining a travel locus on the basis of car position data 33a which are successively output from the dead reckoning navigation device 33, and a map matching means 37 for comparing travel locus data 36a output from the travel locus calculation means 36 with road data 2a read out from the road map data base

2 to correct the current position of the car so that the car is located on a road in consideration of features of the travel locus such as crossings, bending points, etc.

DEPR:
When no setting operation is carried out for the current position of the car (initial position), the car position detection control means 38 in the car position detector 3 supplies the dead reckoning navigation device 33 with position data 35a output from the GPS position measuring device 35 as an initial position or temporary position data 38a, and also outputs it as car position data 3a. The car position detection control means 38 supplies the dead reckoning navigation device 33 with position correction data 37a which are output from the map matching means 37 to correct the current position data of the car, and supplies the navigation control unit 7 with the newest car position data 33a which are successively output from the dead reckoning navigation device 33 as the car position data 3a.

DEPR:
The destination input means 4 and the place name input means 5 (see FIG. 1) are designed to input a destination and a place name serving as a target for the course judgment with a voice using a voice recognition device 40. The voice recognition device 40 can recognize the voice of any speaker, and its recognition rate can be improved by beforehand registering the voice of a specific speaker (for example, a driver).

DEPR:
Therefore, the voice recognition device 40 includes a level adjustment circuit 42 having an AGC function for adjusting the output signal 41a of a microphone 41 to a predetermined signal level, a noise removing circuit 43 for removing noise components and emphasizing a specific frequency band component and removing undesired frequency components so that a voice signal is suitable for voice analysis, a voice analyzing circuit 44 for analyzing the features of a voice signal 43a for analysis from which the noise components are removed and which has frequency components suitable for the voice analysis to code the voice signal 43a, a collate circuit 46 for comparing and collating the analysis data (voice input) 44a output from the voice analysis circuit 44 and the analysis data (comparison reference) 45a supplied from an analysis data storing circuit 45 to output analysis result data 46a representing coincidence or similarity degree for these analysis data, a recognition result output means 47 for outputting a destination input command 47a and place-name input data 4b on the basis of the analysis result data 46a, monosyllable data and vocabulary data 45b, a register control means 48 for registering the voice of a specific speaker, a key input interface (I/F) circuit 49 and an operation unit 50 having various operation keys.

DEPR:
The operation unit 50 includes a destination key 51 for registering a command voice (command words) when the destination is input with voice, a road guide key 52 for registering an command voice (command words) for starting a road guide operation, cursor shift keys 53a to 53d for scrolling a map displayed on the screen of the image display device 9 and registering an command voice (command words) to shift a position indicating cursor displayed on the map, an enter (set) key 54 for registering an command voice (command words) to determine and input the position of the shifted cursor, and a voice register key 55 which has plural keys and serves to register the voiceless sounds of the Japanese syllabary, the voiced sounds, the syllabic nasal in Japanese, numerals, words such as alphabetic letters, etc. in accordance with the pushing frequency of each key and the combination of pushed keys (multi-pushing).

DEPR:
On the other hand, the specific speaker such as a driver or the like can register his favorite words in accordance with the operation of the keys 51 to 55. Any words such as "the end of travel" and "which course" may be used and registered for the destination setting and the start of the course guide, respectively. The words of "ue", "shita", "hidari", "migi", "up", "down", "left", "right", etc. may be used and registered as command words (key words) for the shift of the cursor and the scroll of the map, and further the word of "OK" may be used and registered as a command word (key word) to determine the cursor position and the map.

DEPR:
The destination setting means 4 and the place-name input means 5 are designed so that the input operation can be performed by using the various keys 51 to 55 of the operation unit 50 and by jointly using the operation of the keys 51 to 55 and the voice. For example, the following actions may be performed. That is, the destination key 51 is pushed to shift the mode to the destination register mode, and then a destination name is input with voice. Thereafter, the road guide key 52 is pushed to shift the mode to the course guide mode, and then the via-place name is input with voice. Accordingly, the recognition result output means 47 monitors the key input information 49a output from the key input interface circuit 49 at all times, and it is designed to generate and output not only the commands corresponding to the voice input, but also the commands corresponding to the key input and data 47a to 47c. Reference numeral 47c represents a cursor shift command for scrolling the cursor position and the map or determining them, and reference numeral 47d represents a voice unrecognizableness output signal representing that the voice recognition cannot be performed.

DEPR:
The operation unit 50 is provided with map type selection keys 56a to 56c for selecting the map type such as a broad area map, a middle area map, a detailed area map or the like. When the map type selection keys 56a to 56c are operated, the corresponding map selection command 47e is output from the recognition result output means 47. The selection of the map type may be performed by voicing a key word such as "broad area map", "middle area map", "detailed area map" or the like.

DEPR:
The voice analysis circuit 44 is provided with a continuous word judgment circuit for judging a series of voice period (phrase) on the basis of an envelope waveform of an analysis voice signal and time variation of a power spectrum, and supplies the judgment result 44b to the collate circuit 46, the recognition result output means 47, the register control means 48, etc. to identify the punctuation of the voice input command. Accordingly, even when plural place names of "Tokorozawa", "Kawagoe" and "Omiya" are input for the course guide, these voices are identified as three kinds of place names, and the place-name input data 47b of the three place names are supplied to the navigation control unit 7.

DEPR:
The destination setting means 4 and the place-name input means 5 shown in FIG. 4 are designed so that the destination and the place names serving as targets for the route judgment can be input with a pen using a hand-write character recognition device 56.

DEPR:
A pen input operation which is conducted on a handwrite input tablet 56a of pressure-sensitive type or electromagnetic induction type is detected by a pen input detector 56b, and the hand-write character recognition means 56d makes an analysis of writer's handwriting, an analysis of the order of making strokes in writing a character, etc. on the basis of the detection output 56c of the pen input detector 56b. The character code data 56e corresponding to the identified characters are supplied to the recognition result output control means 57a in the recognition result check/output control unit 57.

DEPR:
The recognition result output control means 57a temporarily stores into a temporary storage means such as a RAM or the like (not shown) the character code data 56e which are successively supplied from the hand-write character recognition means 56d while considering the supply order (the handwriting order).

DEPR:
An operation input unit 58 comprising a transparent touch panel switch or the like is provided on the display screen of the operation unit display 57c, whereby the operation input areas 58a to 58e corresponding to functional displays such as destination setting, course guide (via-place input), input mode switching, cancel (one-character delete for hand-written characters), OK (input character check), etc. are operated with a pen tip or a finger to perform the input of various kinds of functions. The input operation of the operation input unit 58 is

detected by the operation input detector 57e, and when the input operation of the destination setting is carried out, the destination input command 47a is supplied to the navigation controller 7.

DEPR:
When supplied with the input mode indication signal 57h representing the cursor shift mode, the hand-write character recognition means 56d outputs a cursor shift command 47c corresponding to the pen input direction (the shift direction of the pen) and the shift distance (or shift speed and shift distance) thereof. Through this operation, the scroll of the map and the shift of the cursor displayed on the map can be performed with the same operation performance as a pointing device (image position indicating device) such as a mouse or the like.

DEPR:
When the detection output of the cancel operation is output from the operation input detector 57d, the recognition result output control means 57a cancels the character code data which are supplied just before the supply of the detection output. Accordingly, the characters which are displayed on the input character check display area 57d are deleted from the rear side one by one every time the cancel operation is carried out. Through this operation, correction can be performed for an erroneous handwriting input or an erroneous recognition of a character. On the other hand, when supplied with the detection output of the OK (input character check) operation, the recognition result output control means 57a successively outputs the character code data corresponding to the character array, etc. which are temporarily stored in the temporary storage means as the place-name input data 47b. Through this operation, the place name of the destination or the place name which is a target for the course guide is supplied to the navigation controller 7.

DEPR:
The hand-write input operation unit 59 having the handwrite input tablet 56a is provided with a pen receiver 59b on which a pen 59a is mounted and fixed for an emergent use, and also provided with a palm rest portion 59c for mounting hands or wrists thereon below and at the side of handwrite input tablet 56a (a hatched area). Therefore, the handwriting input operation can be more stably performed even when running vibration occurs.

DEPR:
The handwrite character recognition unit 56d is designed to recognize only characters of Hiragana or Katakana, numerals and some symbols so that the data amount required for the analysis of the writer's handwriting and the order of making strokes in writing a character is reduced to reduce the storage area of these data, and a time required for recognition is shortened.

DEPR:
The handwriting input tablet 56a may be formed of transparent or excellently light-permeable material and disposed on the display screen of the operation unit display 57c.

DEPR:
The data base access means 71 has a function of indicating the map type such as the broad area map, the middle area map, the detailed area map or the like on the basis of the map selection command 47e, and a function of generating and outputting an access request signal 2a for accessing the corresponding data on the basis of the car position data 3a successively output from the car position detection means 3, the position data 73a output from the pronunciation-position management means 73, and a search request 73b.

DEPR:
The pronunciation-position management means 73 corresponds to a so-called dictionary for place names in which the position data 73a are output on the basis of the place-name input data 47b. On the basis of the presence or absence of the destination input command 47a, it judges whether the place-name input data 47b supplied from the voice recognition device 40 or the handwrite character recognition device 56 corresponds to the place name of the destination or the place name of a via-place or the like, and outputs the position data 73a containing information on the destination/via-place, etc.

DEPR:

In order to set the destination itself, the adjacent maps are successively searched on the basis of the car current position as a reference position to shorten the search time. However, even by this manner, the search time may be long when the destination is far away from the current position.

DEPR:
The route judgment means 76 includes a temporary storage device (for example, RAM) for temporarily storing the position data of the destination (MD), the car position data (JD) 3a and judgment target position data (KD1, KD2, KD3, . . .) corresponding to the via-places input for the course suitability judgment. The route judgment means 76 judges it on the basis of each position data (MD, JD, KDn), the map data 72a and a route judgment method as described later whether a route extending to the destination is suitable, and outputs the judgment result 8a.

DEPR:
When supplied with the search preferential direction guide request 73b from the pronunciation-position management means 73, the route judgment means 76 outputs data on a direction extending from the car position (J) to the destination (M) as preferential search map information 73d. When the route judgment means 76 can recognize the numbers or the like for the road maps, the number data or the like for a sectional map which is adjacent to the currently-displayed map in the direction extending to the destination may be output as the preferential search map information 73d. Furthermore, a relative direction of a map to be preferentially searched with respect to the currently-displayed map, such as a north side, an east side or the like, may be merely output.

DEPR:
When the route judgment means 76 receives a signal 47d representing that a place name or the like input by voice or handwrite cannot be recognized, from the destination setting means 4 and the place name input means 5 constructed by the voice recognition device 40 or the handwrite character recognition device 56, or receives a signal 73e representing that there is no place name concerned, from the pronunciation-position management means 73, the route judgement means 76 supplies the judgment result output means 8 with a judgment result 8a representing that the input is requested to be carried out again, or that the judgment cannot be performed. In this case, through the voice output means 80 in the judgment result output means 8, a voice guide message such as "please input once more", "the name of .DELTA..DELTA. is not registered" or the like is output, and through the image output means 90 in the judgment result output means 8, message image data 90a such as "please input again", "the place name is unrecognizable" or the like is generated to display the guide image message on the screen of the image display device 9 through an image synthesizer 78 and a display device interface unit 79.

DEPR:
On the basis of the car position data 3a, the position data 73a for the place names containing classification information of destination/via-place, etc. and the map 72a, the guide information generator 77 generates and outputs a mark indicating an advance direction, a mark indicating the destination position, a mark indicating the position of a place name input for route judgment, and guide image data 77a on various guide information such as a line connecting the car position and the destination, a line connecting the car position and the position of a place name input for the route judgment (the respective lines are different in line type or display color), etc.

DEPR:
The guide information generating means 77 controls the shift of the position of the cursor displayed on the screen of the display device 9 on the basis of the cursor shift command 47c, and supplies the destination position register data 77b to the route judgment means 76 when the destination is registered by the determination input of the cursor position while it supplies the current position register data 77c to the car position detector 3 when the current position is registered.

DEPR:
In the suitability judgment manner shown in FIG. 7, a route is judged to be suitable if an intersectional angle .theta. between a line J-M connecting the current position (car position) J and a destination M and a line J-M connecting

the current position (car position) J and the position K of an input place name is smaller than a predetermined threshold angle .theta.th (for example, 60 degrees). If an angle between the destination direction and the direction of a place name serving as a judgment target is above 120 degrees, for example, a judgment result 8a representing that the direction should be inverted is output, and a message "the advance direction is opposite" or the like is given to the driver or the like.

DEPR:
When plural place names are input as judgment targets, intersectional angles .theta.1 between a line J-K1 connecting the current position (car position) J and the position K1 of a judgment target and a line J-M connecting the current position J and the destination M, .theta.2 between a line J-K2 connecting the current position J and the position K2 of another judgment target and the line J-M, and .theta.3 between a line J-K3 connecting the current position J and the position K3 of the other judgment target and the line J-M, are calculates as shown in FIG. 7(b), the place name which provides the smallest intersectional angle below the threshold value .theta.th is judged to be the most suitable place name for the route.

DEPR:
For example, when two or more via-places are input and the angles .theta.1 and .theta.2 shown in FIG. 7(b) are substantially equal to each other, the route judgment means 76 calculates the road distance of each route extending from the current position (car position) J through each input via-place name to the destination M on the basis of the map data 72a, and one of the via-place names which provides the shorter travel distance is judged as being suitable.

DEPR:
In this case, the road distance of the route extending through the input via-place name to the destination M is calculated when it is satisfied that the input place name is located at the car position side with respect to the destination M (nearer to the car position than the destination M). On the other hand, the road distance from the current position (car position) to the destination M is calculated when the input place name is farther away from the current position than the destination M.

DEPR:
When the map data 72a contains information to discriminate superhighways, etc. and general roads from one another, the route judgment means 76 may calculate the value corresponding to an estimation time which is estimated to be taken until the car arrives at the destination, thereby performing the higher judgment containing the route information.

DEPR:
As shown in FIG. 8(a), the route judgment means 76 compares a route (PJM) extending from the car position (current position) J to the destination M with a route (PJK) extending from the car position (current position) J to the position K of an input place name to judge whether there is a common portion between the routes (PJM) and (PJK). If there is a common portion PJC, the route judgment means 76 outputs the judgment result 8a representing that selection of the route extending to the input place name is suitable, and supplies audibly or visibly a message of "OO", "Please go to O direction" or the like through the judgment result output means 8.

DEPR:
In FIG. 9(c), it is assumed that the place names of big cities or important positions of transportation exist around (far away from or in the neighborhood of) the destination, and a place name which is located within an area B having a radius of R from the destination M is judged as "suitable". In the manners of FIGS. 9(a) and 9(b), as the car approaches to the destination, the area permitting the "suitable" judgment is narrower. Therefore, there occurs a case where "NO" message is more frequently output even when a place name is input. However, by setting the area B having the destination M at the center thereof, the car can be navigated into the area having the predetermined radius R from the destination M.

DEPR:
In FIG. 9(d), an area B having the destination M at the center thereof and an

egg-shaped area A whose wider portion is set at the car position J side (near to the car position J) are combined with each other to set a gourd-shaped area as a whole. Accordingly, even when the car is located at the current position and approaches to the destination M, the frequency of the message "NO" is reduced.

DEPR:
When the position data 73a of a place name such as a via-place or the like is supplied from the pronunciation-position managing means 73, the route judgment means 101 supplies a course guide map automatic selection means 102 with the position data 101a (JD,MD,KD) of the car position J, the destination M and the via-place or the like K.

DEPR:
The road guide map automatic selection means 102 has range data of each sectional map every reduced scale such as a detailed area, a middle area, a broad area, etc., and it first searches such a map as contains all the car position J, one or plural via-places, etc. K and the destination M. If there is the map concerned, it supplies the map indication data 102a indicating the map to the data base access means 71 to read out the data of the corresponding sectional map from the road map data base 2.

DEPR:
There is no sectional map containing all the car position J, the destination M and the via-places, etc. K, the road guide map automatic selection means 102 searches a sectional map containing the current position J and at least one via-place K, or a sectional map containing the current position J and the destination M. If the selected map does not contain the destination M, the road guide map automatic selection means 102 outputs information representing the fact to the route judgment means, 101, and if there is a via-place which is not contained in the selected map, the road guide map automatic selection means 102 outputs information 102b on the via-place to the route judgment means 101.

DEPR:
If a sectional map containing the car position J, the destination M and all the input via-places, etc. K, the route judgement means 101 supplies the position data 101b thereof (MD,KD) to the guide information generating means 103. On the basis of each position data 101b (MD,KD), the guide information generating means 103 generates image data for displaying a mark MM indicating the destination position and a mark MK indicating the position of each of the input via-places, etc. at the corresponding positions, and generates image data of lines LM and LK which connect the car position mark MJ based on the car position data 3a and the respective marks MM, MD. Thereafter, it supplies the generated image data 103a for the road guide to the image synthesizer 78. Through this operation, the road guide information is displayed on the screen of the image display device 9 while superposed on the road map.

DEPR:
A case where the destination and all the input via-places are displayed at the same time is shown in FIG. 11(a). MM represents a mark indicating the position of the destination M, MK1 to MK3 (MKn) represent marks indicating the positions of the respective input via-places K1 to K3 (kn), MJ represents a mark indicating the vehicle position, LM represents a line connecting the vehicle position and the destination, and LK1 to LK3 (LKn) represent lines connecting the respective via-places, etc. to the vehicle position, respectively.

DEPR:
Thereafter, the guide information generating means 103 displays the line LM extending from the vehicle position to the destination, the line extending from the vehicle position to the via-place or the like which is judged to be suitable (in this embodiment, line LK2), and the lines extending from the vehicle position to the other via-places (in this embodiment, lines LK1, LK3) with different line types (thickness of line, the kind of line such as a solid line, a chain line, etc.) or different display colors so that these lines are discriminable from one another.

DEPR:
Therefore, when the driver or the passenger inputs one or plural place names written on a road sign or the like into the car navigation system 1, a suitable route is indicated with a voice message, and a road map containing the

destination and the input place name(s) is reproduced and displayed on the screen 9a of the image display device 9. In this case, the positions of the destination and the input via-place names, the vehicle position and the lines connecting the vehicle position to these positions are displayed on a map in such a way as to be easily visible, so that the route can be checked using the map display in combination.

DEPR:
When any map which contains the positions of all place names serving as targets for the route judgment cannot be selected, the route judgment means 101 supplies the guide information generating means 103 with place-name data on the positions of the place names which cannot be displayed on a selected map, and data 101b on the direction extending from the vehicle position to each of the positions of these place names and the distance in a straight line extending from the vehicle position to each of the positions.

DEPR:
Upon reception of these data 101b, the guide information generating means 103 displays an arrow extending from the vehicle position to the destination and an arrow extending from the vehicle position to a via-place or the like, and generates image data for guide information JM on the destination which indicates the place name of the destination and the distance to the destination at the arrow side, and for guide information FJK on the place names of the via-places and the distance of the straight line.

DEPR:
A car navigation system according to a preferred embodiment includes route judgment means for judging whether an input place name is suitable for a route extending to a destination, and judgment result outputting means for outputting a judgment result of the route judgment means. Accordingly, by inputting a place name written on a road sign or the like, it can be suitably guided which course should be selected. Therefore, even when a driver or the like does not recognize the geographical relationship between a destination and a place name written on a road sign or the like in a geographically unfamiliar area, he can take the suitable course on the basis of the place name written in the road sign or the like.

DEPR:
In a car navigation system according to an alternate embodiment, place names indicated on a map which is reproduced and displayed on a screen by an image display device and data on pronunciations of the place names (written in Kanji) are provided to a road map data base. Therefore, place names such as via-places, etc. can be specified by inputting the place names with voice using a voice recognition device. Furthermore, when a hand-writing input device is used, the place names such as via-places can be also specified by inputting the place names in Hiragana or Katakana with a pen or the like. Accordingly, a hand-writing character recognizing unit of this system can be more facilitated in construction than a hand-writing input device which needs recognition of Kanji. In addition, it is difficult to accurately input complicated Kanji characters during running because of car vibration. On the other hand, the Hiragana or Katakana input of the place names makes the hand-writing input operation more easily.

DEPR:
In a car navigation system according to another alternate embodiment, in addition to accurate (formal) pronunciations for place names, data on other pronunciations for the place names are provided. Accordingly, even when the driver or the like does not known the formal place names because of a geographically unfamiliar area, the place names written on road signs, etc. can be input by voicing or hand-writing an adequate pronunciation for each place name.

DEPR:
Furthermore, the destination input means and the place-name input means are constructed by using the voice recognition device or the handwrite character recognition device, the destination and the via-places can be easily input.

DEPR:
Whether the input place name is suitable as a via-place is output with voice using the voice synthesizer. On the screen of the image display device are displayed a map containing the current position of the car, and the lines

connecting the current position to the destination and to the input place name (via-place).

CLPR:
1. A car navigation system comprising:

CLPR:
2. The car navigation system as claimed in claim 1, wherein said road map data base includes

CLPR:
3. The car navigation system as claimed in claim 2, wherein said road map includes

CLPR:
4. The car navigation system as claimed in claim 1, wherein said destination input means and said place-name input means are constructed by a voice recognition device.

CLPR:
5. The car navigation system as claimed in claim 1, wherein said destination input means and said place-name input means are constructed by a handwritten character input device and a handwritten character recognition device.

CLPR:
6. The car navigation system as claimed in claim 1, wherein said route judgment means judges on the basis of an intersection angle between a line connecting the current position of the car and the destination and a line connecting the current position of the car and the position of the input place name whether the direction of the input place name is the same as the direction of the destination.

CLPR:
7. The car navigation system as claimed in claim 1, wherein said route judgment means compares a route extending from the current position of the car to the destination with a route extending from the current position of the car to the position of the input place name, and judges on the basis of the distance of a common portion between the routes whether the direction of the input place name is the same as the direction of the destination.

CLPR:
8. The car navigation system as claimed in claim 1, wherein said route judgment means sets a prescribed area at both sides of a line connecting the current position of the car and the destination, and judges the input place name to be suitable as a via-place if the input place name is within the set area.

CLPR:
9. The car navigation system as claimed in claim 1, wherein when the destination is far away from the current position of the car, said route judgment means judges the input place name to be suitable as a via-place if the input place name is located at a prescribed distance or less from the destination.

CLPR:
10. A car navigation system as claimed in claim 1, wherein when the input place name contains a route on which the car can run at a higher speed than on a general road, said route judgment means converts the distance of the route to a shorter value than the actual distance thereof to calculate the distance to the destination, and a route through which the car arrives at the destination most early is selected on the basis of the converted distance.

CLPR:
11. The car navigation system as claimed in claim 1, wherein said route judgment result output means comprises a voice synthesizer.

CLPR:
12. The car navigation system as claimed in claim 1, wherein said judgment result output means comprises an image display device having a screen, wherein said image display device displays a map containing the current position of the car on the screen and further displays a line extending from the current position of the

car to the destination and a line extending from the current position of the car to the position of the input place name on the screen.

CLPR:
13. A navigation method for a vehicle navigation system, comprising the steps of:

CLPV:
a car position detecting device for detecting a current position of a car on a road map of said road map data base;

CLPV:
directing the vehicle along the calculated travel route;

CLPV:
while the vehicle is on route to said desired destination, inputting a place name other than said desired destination into the system;